

# jsc

National Aeronautics and  
Space Administration



R O U N D U P

SUMMER 2016



**BEAM  
me up**

# The director of JSC

## Ellen Ochoa



PHOTO: NASA

### JOHNSON SPACE CENTER HAS ALWAYS BEEN KNOWN AS A CENTER THAT LEADS.

In the past few months, the JSC senior leadership team reviewed our existing strategic implementation plan, along with the NASA vision to develop a new JSC mission statement that reemphasizes and focuses on our role of leading human space exploration (while being succinct and easy to remember). As part of this JSC 2.0 development activity, we sought input from you—our JSC team—through centerwide focus groups and received invaluable feedback to help shape our future.

Recently, I announced our new mission statement for our center: “Lead Human Space Exploration.”

With this strong statement comes four priorities:

- **Maximize** the use of the International Space Station
- **Enable** the success of the Commercial Crew Program
- **Develop** Orion for future missions
- **Build** the foundation for human missions to Mars

And, in keeping with the JSC 2.0 focus on how we do our work, we intend to implement these priorities with the following emphases:

- **Focus** ... on our priorities
- **Improve** ... our ways of doing business
- **Challenge** ... inefficient and outdated processes
- **Collaborate** ... across organizations, centers and the space community

Our work also led us to rebrand JSC 2.0 to JSC 2.016, to revitalize the endeavor and focus on what we’re doing this year to be more lean, agile and adaptive to change. These efforts remain vital to our ability to advance human space exploration beyond low-Earth orbit.

You will be hearing more about our next steps for JSC 2.016 and my thoughts about how we will implement these changes from your directors and managers. Additionally, Mark Geyer and I will continue to host coffee chats to seek input on how we can work together to create an environment of change that will help us advance human spaceflight. I also invite you to send your questions and suggestions to [JSC-Ask-The-Director@mail.nasa.gov](mailto:JSC-Ask-The-Director@mail.nasa.gov), or check out our new internal website for the latest information.

*Ellen Ochoa*

IMAGE CREDIT: ESA/NASA



**EXPEDITION 47 FLIGHT ENGINEER TIM PEAKE** of ESA (European Space Agency) photographed rare, high-altitude noctilucent—or “night shining”—clouds from the International Space Station on May 29. Polar mesospheric clouds, also known as noctilucent clouds, form between 47 to 53 miles above Earth’s surface, near the boundary of the mesosphere and thermosphere, a region known as the mesopause. At these altitudes, water vapor can freeze into clouds of ice crystals. When the sun is below the horizon and the ground is in darkness, these high clouds may still be illuminated, lending them their ethereal, “night shining” qualities.

# HUNCH students' galley table aboard the International Space Station

**WHEN IT COMES TO MANUFACTURING SKILLS,** local high school students have a lot to bring to the table—a very literal space-bound table.

Student teams from Cypress Woods High School, Cypress Springs High School and Clear Creek High School built a galley table for International Space Station astronauts through the High school students United with NASA to Create Hardware (HUNCH) program.

The students partnered with HUNCH mentors and private companies to develop and launch the galley table aboard the Cygnus cargo vehicle during the Orbital Sciences CRS Flight 6 on March 22. The Expedition 47 crew installed the table in the station's Unity module in April.

When Expedition 47 Commander Tim Kopra had a chance to evaluate the table, he commented on the nice smooth surface that was easy to clean, as well as the green color that livened up the otherwise white and gray interior of the space station.

"We've become very fond of all of its features," Kopra said. "It's an integral part of space station now."

In its basic configuration, the table can comfortably accommodate three crew members. However, there's an extension they can fold out when the full international crew eats together. Kopra explained it is much like adding a leaf to the table when you have company over.

While there's no real "up" or "down," and you can float around with your food wherever you want in microgravity, gathering around a table is a familiar slice of home ... even if you have to secure your food to it with Velcro.

"We now have a means of all six of us gathering around a table, which we really didn't have before," Kopra said. "We are very thankful for all the work you have done."

To hear more of Kopra's comments and see the table, watch the YouTube video:

[https://youtu.be/NV-i\\_10HiZA](https://youtu.be/NV-i_10HiZA)

To learn more about HUNCH, visit:

<https://www.nasahunch.com>



Astronauts Tim Kopra, Jeff Williams and Tim Peake enjoy a meal together around their new galley table designed by students in the HUNCH program.

PHOTO: NASA

# From space to sea to scientists

## SpaceX return of samples marks next step in one-year mission science

**MORE THAN ONE THOUSAND TUBES OF BLOOD**, urine, and saliva made their way back to Earth from the International Space Station (ISS) aboard the SpaceX-8 Dragon capsule, signaling an exciting next step for the scientists leading research for the recently completed one-year mission. NASA astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko returned to Earth from their yearlong mission aboard the orbiting laboratory in March, but many of the samples critical to the continuation of research have only made their way back to labs at the tail end of spring.

"[It's] like Christmas in May, with frost to boot," said Scott M. Smith, who holds a doctorate in nutrition and is a principal investigator of the Biochemical Profile investigation.

Smith was referring to the specialized cold stowage needed to safely transport temperature-sensitive samples. After being collected in space, crew members store the samples in the Minus Eighty-Degree Laboratory Freezer for ISS. The tubes are transferred to either powered freezers or insulated coolers with special ice packs, which are then packed inside the SpaceX Dragon capsule to be returned to Earth.

"SpaceX provides our primary capability for sample return, allowing us to bring home freezer bags and powered freezers containing samples," said Julie Robinson, chief scientist for the space station, who holds a doctorate in biology.

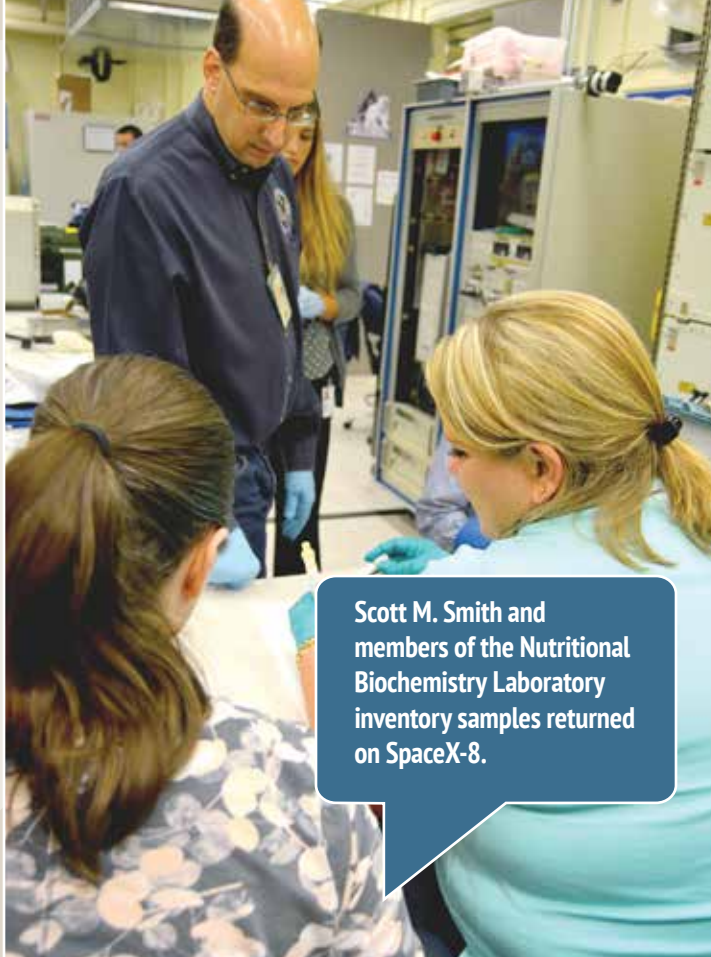
After splashing down in the Pacific Ocean, the Dragon capsule was loaded onto a ship and taken to shore in Long Beach, California. Members of NASA Johnson Space Center's Cold Stowage team transferred the samples to a charter aircraft, where portable, powered freezers awaited. While some investigators were on hand to retrieve their samples directly from the Cold Stowage team aboard the aircraft, most of the precious cargo was flown back to Houston for distribution at JSC.

"Samples coming home on SpaceX include samples from a variety of human experiments," said Robinson. "Most notably blood, urine and saliva collected from the crew for the one-year mission and Twins Study."

Studies supported by the samples coming back in this batch include Biochemical Profile, Cardio Ox, Fluid Shifts, Microbiome, Salivary

A SpaceX Dragon cargo spacecraft splashes down in the Pacific Ocean May 11, about 261 miles southwest of Long Beach, California, with more than 3,700 pounds of NASA cargo, science and technology demonstration samples from the space station.





Scott M. Smith and members of the Nutritional Biochemistry Laboratory inventory samples returned on SpaceX-8.

#### Markers and the Twins Study.

"The inventory process is actually pretty intense," Smith said. Members of the Cold Stowage team hand samples off to researchers, who are assigned time slots for retrieving their precious cargo.

"We inventory and check every tube serial number against what we expected," Smith said. "Once we have all of [our samples], and are sure we don't have anything we're not supposed to, official documents are signed, and we bag them up to carry back to the lab."

Once back in their lab, also on-site at JSC, Smith's team will unpack and re-inventory everything once again to ensure nothing was lost in the dry ice or during the return to the Nutritional Biochemistry Lab. From there, the samples will be packed in laboratory minus 80-degree freezers until further preparation for analysis.

Stuart Lee, who holds a doctorate in kinesiology and is the principal investigator for the Cardio Ox and Cardio Ox Twins investigations, said many of the samples will be shared between his and Smith's biochemical profiles investigation. Lee said that seven subjects have completed their mission for Cardio Ox, but samples for only three of those had been previously returned to Earth.

"Given that, we will more than double the amount of data that we have for Cardio Ox with this sample return," Lee said. "Of course, we also get the excitement of starting to receive the data from the one-year mission."

Lee said that up until now, scientists' data have described the effects of spaceflight from the typical six-month missions to the space station, but data from the one-year mission samples will change that.

"This will be NASA's first glimpse at the effects of space travel,

which start to approach that which we might expect from a Mars mission," Lee said.

Samples for the Twins Study, in which Kelly and his identical twin brother, retired NASA astronaut Mark Kelly, participated, also returned on SpaceX-8. The blood and urine components of those studies offer new molecular analyses for investigators.

"With these samples we will have pilot data to understand spaceflight effects on and linkages between genetic expression, protein expression and physiology, improving our understanding of the cardiovascular system in space, as well as astronauts' ophthalmologic issues," Lee said.

This batch of samples includes the final collection returning from space for the one-year mission investigations. While some of the investigations include several data collections in the year—or longer—beyond the crew's return to Earth, analysis of the returning samples can begin, in most cases, when they reach the scientists' laboratories. Twins Study investigators have agreed to wait until after the return plus six-month data collection completes in September 2016.

Smith said organization, tracking and careful planning is critical to successful analysis.

"We analyze over 100 chemicals in each blood sample and over 30 in each urine sample," Smith said. "We try to have samples available for the folks analyzing them as quickly as possible. Nonetheless, depending on the type of test and number of samples, it can take quite a bit of time."

With samples being delivered to investigators across the country, Smith remains optimistic that the bulk of testing on these samples will be completed by the end of the year.

"[The research is] very carefully plotted out and planned, reviewed, documented and then executed," Smith said. "We only get one shot at this."



Members of the Cold Stowage Lab unpack samples of blood, urine and saliva that returned aboard SpaceX-8. Samples are kept on dry ice as they are delivered to science team members.



# BEAM opens up worlds of possibility

## INFLATED SENSE OF WORTH? NAH, JUST INFLATED.

The general public and sci-fi enthusiasts alike are feeling “buoyant” about the possibilities of future outposts beyond Earth orbit, thanks to the successful inflation of the Bigelow Expandable Activity Module (BEAM) habitat on the International Space Station.

It took a bit longer than initially planned, but crew members completed the expansion of BEAM in late May, opening up safe and cost-effective methods to grow our presence in the solar system.

NASA astronaut Jeff Williams began carefully pressurizing BEAM on May 26, and did not finish until late on May 28. Ground teams elected to stretch expansion over a few days because pressure was building too quickly inside the capsule and the structure was not expanding at the expected rate. BEAM expanded from just more than 7 feet long and 7.75 feet in diameter in its packed configuration, to 13 feet long and about 10.5 feet in diameter.

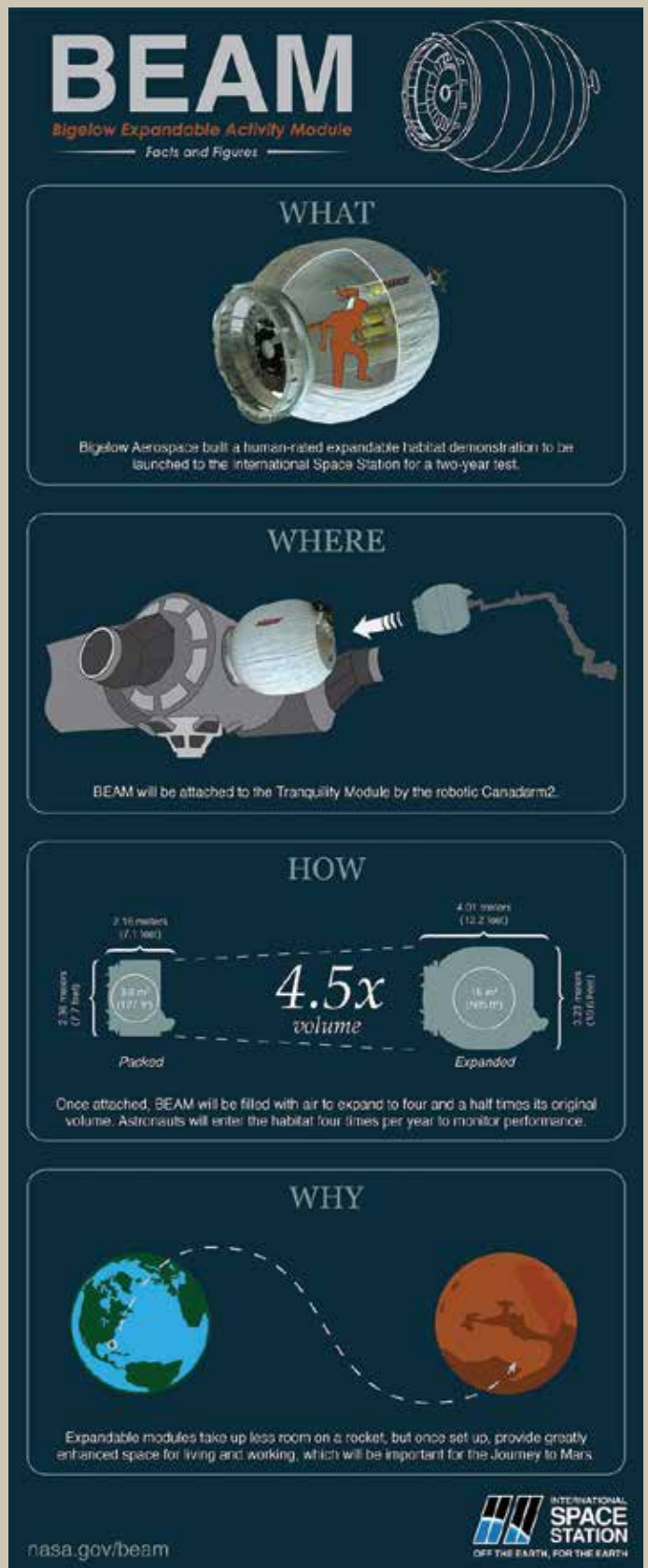


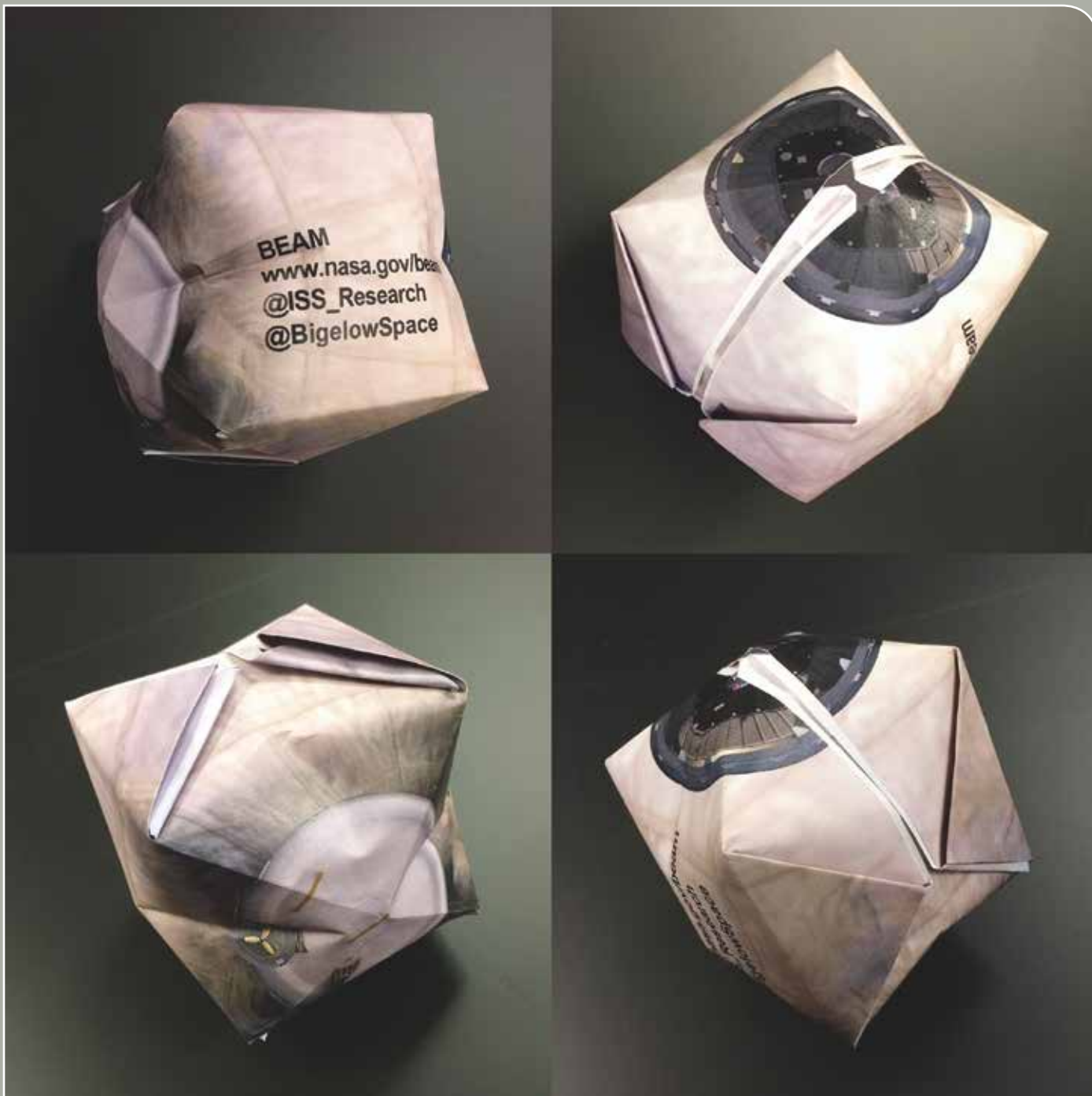
NASA/PHOTO

NASA astronauts Jeff Williams (left), Tim Kopra (center) and ESA (European Space Agency) astronaut Tim Peake (right) gather in front of the BEAM hatch during a break in expansion operations.

Expandable habitats are designed to take up less room on a spacecraft but provide greater volume for living and working in space once expanded. This first test of an expandable module will allow investigators to gauge how well the habitat performs and, specifically, how well it protects against solar radiation, space debris and the temperature extremes of space. Durable, reliable and safe expandable structures have a wide variety of applications on Earth as well. Expandables can be used as pop-up habitats in disaster areas or remote locations; storm surge protection devices; pipeline or subway system plugs to prevent flooding; fluid storage containers; or hyperbaric chambers for pressurized oxygen delivery.

In June, leak checks on BEAM ensured its structural integrity, leading to a hatch opening and Williams' acquaintance with the interior of the ballooned module.





NASA/PHOTO

## For the kids (or the kids at heart)—make origaBEAMi!

*An origami paper-folding activity to create and expand your own miniature BEAM module.*

Watch a video and get instructions for this fun summer activity here:

<http://go.usa.gov/chAmQ>

# Between a rock and a hard place— lies answers

Years ago, it was a concept envisioned for NASA's New Frontiers Program.  
Now, on Sept. 8, the concept will take flight.

**EARLY THIS FALL**, the first U.S. mission to sample an asteroid—NASA's Origins, Spectral Interpretation, Resource Identification, Security - Regolith Explorer (OSIRIS-REx) spacecraft—will travel to and collect surface material from the asteroid Bennu and return it to Earth for study. Though the samples won't be back for some time—2023, to be precise—Johnson Space Center's Astromaterials Research and Exploration Science Division will be part of the historic mission from launch to return.

Scott Messenger, a senior Astromaterials and mission scientist, is a co-investigator on OSIRIS-REx and lead of the sample analysis group. He is one of eight OSIRIS-REx team members from JSC taking part in the mission.

Messenger will be at Kennedy Space Center during launch prep, taking samples of the cleanroom air and nitrogen purge gas as the spacecraft undergoes a last round of testing and integration onto the rocket. These contamination-knowledge studies will help determine what types of contaminants are most likely present in the return material.

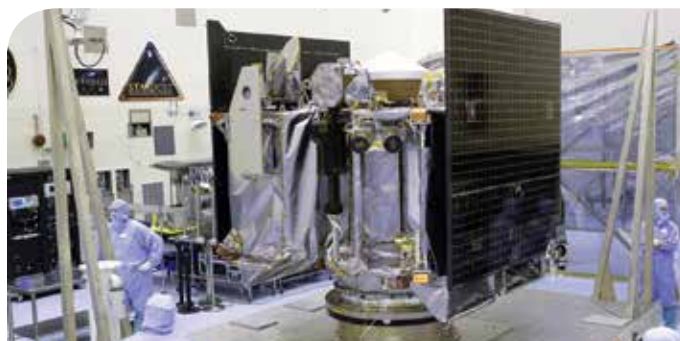
An  
artist's  
concept of  
the OSIRIS-REx  
spacecraft at  
Bennu.



"A primary goal of this mission is to return a pristine sample of a primitive, organic and water-rich asteroid so we can study the solar system's starting materials and the nature of primordial organic matter," Messenger said. "We believe that Bennu is a primitive, carbonaceous near-Earth asteroid based on detailed astronomical observations and comparisons with meteorites we have in the laboratory."

Such primitive asteroids contain original material from the cloud of dust and gas that gave rise to our solar system more than 4.5 billion years ago and could yield important clues about its formation.

The returned samples will be curated for international study and examined by a range of scientific instruments that will probe the mineral and organic composition on a microscopic scale. These investigations will help us understand the full arc of Bennu's history, from dust formation in ancient stars to the present day. OSIRIS-REx will also clarify the links between thousands of meteorites JSC has studied and their potential source bodies based on remote



NASA's OSIRIS-REx spacecraft is revealed after its protective cover is removed inside the Payload Hazardous Servicing Facility at Kennedy Space Center.

NASA/DIMITRI GERONDIKAKIS

spectroscopy.

"OSIRIS-REx is equipped with a powerful suite of cameras and spectrometers that will characterize the global surface composition of Bennu," Messenger said. "These instruments will help select the sampling site."

OSIRIS-REx will retrieve at least 60 grams (2.1 ounces) of surface material from Bennu. Though it may not sound like a lot, it will be enough to help answer questions about the universe that have been notoriously difficult to uncover. The mission is a critical steppingstone to more ambitious missions such as future comet sample return and human missions to near-Earth objects.

"The OSIRIS-REx science team brings together an impressive array of scientific expertise and cutting-edge, world-class scientific instrumentation," Messenger said. "Rarely has there ever been such a powerful combination of talent, experience and analytical capability been brought to bear on analysis of primitive astromaterials."

For more information about OSIRIS-REx, visit:  
<http://www.nasa.gov/osiris-rex>

## THE JSC OSIRIS-REx TEAM:

- Scott Messenger, co-investigator
- Kevin Righter, co-investigator
- Keiko Nakamura-Messenger, co-investigator
- Lindsay Keller, co-investigator
- Simon Clemett, collaborator
- Kathie Thomas-Keprta, collaborator
- Aaron Burton, collaborator
- Ann Nguyen, collaborator

# A triumphant return

**EXPEDITION 47 COMMANDER TIM KOPRA OF NASA**, flight engineer Tim Peake of ESA (European Space Agency) and Soyuz Commander Yuri Malenchenko of Roscosmos returned to Earth on June 18 after wrapping up 186 days in space and several NASA research studies in human health.

The crew completed the in-flight portion of NASA human research studies in ocular health, cognition, salivary markers and microbiome. From the potential development of vaccines to data that could be relevant in the treatment of patients suffering from ocular diseases, such as glaucoma, the research will help NASA prepare for human long-duration exploration while also benefiting people on Earth.

The three crew members also welcomed four cargo spacecraft, including one that delivered the Bigelow Expandable Activity Module, an expandable habitat technology demonstration.

Two Russian Progress cargo craft docked to the station in December and April, bringing tons of supplies. Kopra and Peake also led the grapple of Orbital ATK's Cygnus spacecraft to the station in March, the company's fourth commercial resupply mission, and the SpaceX Dragon spacecraft in April.

During his time on the orbital complex, Kopra ventured outside for two spacewalks. The objective of the first spacewalk was to move the station's mobile transporter railcar to a secure position. On



NASA/BILL INGALLS

Tim Kopra of NASA is helped out of the Soyuz TMA-19M spacecraft just minutes after he and Yuri Malenchenko of Roscosmos and Tim Peake of ESA landed in a remote area near the town of Zhezkazgan, Kazakhstan, on June 18.

the second spacewalk, Kopra and Peake replaced a failed voltage regulator to restore power to one of the station's eight power channels. Kopra now has 244 days in space on two flights, while Peake spent 186 days in space on this—his first—mission.

Having completed his sixth mission, Malenchenko now has spent 828 cumulative days in space, making him second on the all-time list behind Russian cosmonaut Gennady Padalka.

Keep up with the International Space Station, and its research and crews, at: <http://www.nasa.gov/station>

## Save the date to collaborate: SpaceCom 2016

**SEEKING COLLABORATIONS?** From Nov. 15 to 17, NASA will participate in the Space Commerce Conference and Exposition 2016—better known as SpaceCom. This three-day event is engineered to highlight the intersection points between terrestrial industries and the aerospace community.

Developed as a catalyst for innovation and growth in the commercial development of space, last year's conference drew more than 1,700 attendees and featured NASA Administrator Charlie

Bolden and Johnson Space Center Director Ellen Ochoa as keynote speakers. Ochoa also chaired the successful first-time event.

SpaceCom 2015 drew more than 1,700 attendees and provided countless opportunities for partnerships and collaboration.

NASA/BILL STAFFORD



This year, NASA Associate Administrator for Human Exploration and Operations Bill Gerstenmaier will be a panelist, addressing "The State of the Global Space Commerce," a deep dive into promising space innovations and how they could impact the world's economy. Other keynote speakers include Jean-Jacques Dordain, former director of ESA (European Space Agency); Robert Bigelow, founder of Bigelow Aerospace; and Garrett Reisman, SpaceX director of Crew Operations.

The Strategic Partnerships Office, in collaboration with the SpaceCom 2016 planning team, projects that the NASA team will be needed to facilitate interactive case-study working groups, lead roundtable sessions and serve as subject-matter experts at the JSC exhibit. This year's event will also offer opportunities to explore ways to transfer NASA technology to the private sector.

Members of the JSC community interested in supporting NASA's contributions to the conference should contact Steven Gonzalez care of the Strategic Partnerships Office email at [Partnerships@mail.nasa.gov](mailto:Partnerships@mail.nasa.gov). Those who wish to attend the conference should contact their conference-reporting representative for information.

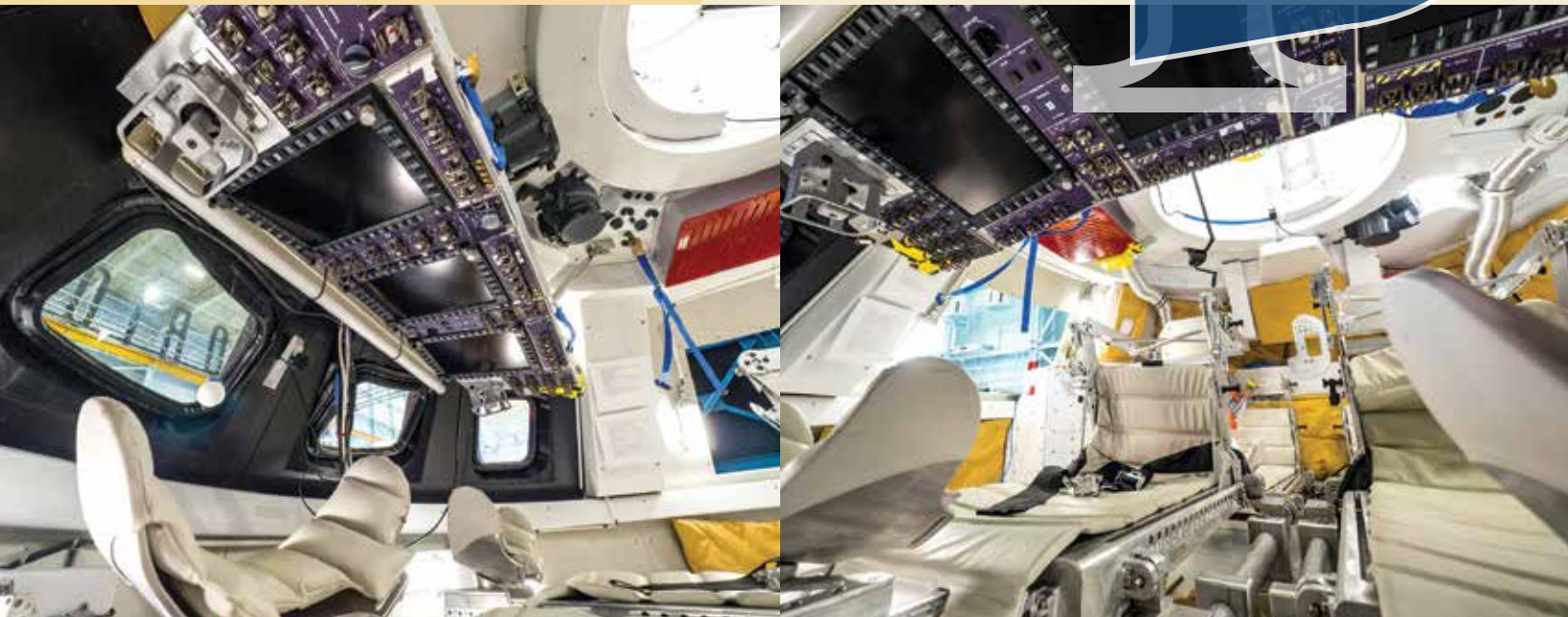
SpaceCom affords JSC team members the chance to share NASA content, products and opportunities while learning more about the commercialization of space.

# Exploration Mission-2 work 'hatched' at Johnson Space Center

**THE ORION TEAM COMPLETED** engineering development unit vibration testing on the Exploration Mission-2 docking hatch here at Johnson Space Center. The team also preformed docking hatch swing/securing engineering evaluations in the full-scale Orion mock-up on May 16 and 17.

Exploration Mission-2, the first crewed mission for Orion, is targeting a launch with astronauts in April 2023.

The Orion medium-fidelity mock-up at JSC is prepped for fit checks of the Exploration Mission-2 docking hatch.



NASA/PHOTO

## Stars abound at Comicpalooza

Did you  
#SpotOrion on the  
way to #Comicpalooza?  
Oh, just another day  
on Houston's  
freeways.



NASA/PHOTO



Orion captivated at #Comicpalooza in Houston from June 17 to 19. Rounding out NASA's stellar presence among the other Earthly (movie) stars: astronauts, robots, rovers and more.

# snapshots



## 100,000 ORBITS

Astronomical numbers on station reached May 20: 100,000 orbits, 1,900 experiments and 222 crew members and visitors. Learn more about these milestones watching Space to Ground: <https://youtu.be/Zn0CEHi5-Lg>



PHOTO: NASA



PHOTO: NASA

IMAGE CREDIT: HOUSTONIA MAGAZINE



## HOUSTONIA MAGAZINE INTRODUCES 'THE NEW WOMEN OF NASA'

In their in-depth piece, meet the four extraordinary women who make up half of NASA's most recent astronaut class: Christina Koch, Nicole Mann, Anne McClain and Jessica Meir. Read more here: <http://bit.ly/1spW91N>

## FLYING FREE

CubeSats fly free after leaving the NanoRacks CUBESAT Deployer on the International Space Station on May 17. Seen here are two Dove satellites. The satellites are part of a constellation designed, built and operated by Planet Labs Inc. to take images of Earth from space. The images have several humanitarian and environmental applications, from monitoring deforestation and urbanization to improving natural disaster relief and agricultural yields in developing nations. A total of 17 CubeSats have been released in this latest batch from a small satellite deployer on the outside of the Kibo experiment module's airlock.

CubeSats are a new, low-cost tool for space science missions. Instead of the traditional space science missions that carry a significant number of custom-built, state-of-the-art instruments, CubeSats are designed to take narrowly targeted scientific observations, with only a few instruments, often built from off-the-shelf components.

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OR CURRENT RESIDENT

## NASA's **Juno mission** on course for July 4 arrival at Jupiter

**NASA IS COOKING UP SOME** planetary excitement this Independence Day—minus a grill—with the arrival of the Juno spacecraft at Jupiter.

Juno is set to reveal the story of the formation and evolution of Jupiter, five years after leaving Earth. It will enter into orbit around the gas giant that evening. Orbital insertion and NASA TV commentary are slated to begin at 9:30 p.m. CDT. More details and times for related Juno events will be announced as they become available (check <http://www.nasa.gov/multimedia/nasatv/>).

Juno will make two 53-day elliptical laps around Jupiter before beginning the mission's science phase. At that point, the spacecraft will begin orbiting the Jovian world every 14 days, from a distance as close as 3,100 miles (5,000 kilometers). It will peer beneath Jupiter's cloud tops to learn about the planet's origins, composition and magnetosphere. Jupiter lies in the harshest radiation environment in our solar system, so this particular spacecraft orbit insertion will mark a new achievement in planetary exploration.



IMAGE CREDIT: NASA/JPL-CALTECH/JSC

In this image, technicians stow for launch solar array no. 2 for NASA's Juno spacecraft. The photo was taken on May 20, 2011, at the Astrotech payload processing facility in Titusville, Florida.

### Juno's got the power—solar power

Just as a bright source of light dims as you move away from it, sunlight becomes less intense the farther a spacecraft travels from the sun, limiting the amount of power that can be generated using solar cells. Previous missions that visited Jupiter, like Galileo, Voyager 1 and Voyager 2, couldn't use solar power and instead used radioisotope thermoelectric generators to supply power.

Advances in solar panel efficiency, along with improvements in the way spacecraft and their instruments use power, have recently made solar power a viable option for spacecraft heading as far as Jupiter—though going beyond will require further technological advances.

Engineers designed Juno with three massive solar panels, each nearly 30 feet long. Combined, they provide Juno with 49.7 m<sup>2</sup> of active solar cells. Once it reaches Jupiter, Juno will generate more than 400 watts of power. It may not sound like a lot, but it's an impressive feat at so great a distance.

**Make your own Juno spacecraft! Activity at this link:**  
<http://go.usa.gov/cSUyR>

**This whimsical montage includes views of Earth and its moon acquired by the JunoCam camera on NASA's Juno spacecraft during the mission's Earth flyby in October 2013.**



IMAGE CREDIT: NASA/JPL-CALTECH/LMSSC